UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ODONTOLOGIA DE PIRACICABA

LIEGE MARIA DI BISCEGLIE FERREIRA

AVALIAÇÃO DE MÉTODO PARA DIAGNÓSTICO DE CEFALEIAS POR MEIO DA ELETROMIOGRAFIA

EVALUATION OF A HEADACHE DIAGNOSIS METHOD TROUGH ELECTROMYOGRAPHY

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Tese apresentada à Faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do título de Doutora em Biologia Buco-Dental, na Área de Anatomia

Thesis presented to the Piracicaba Dental School of the University of Campinas in partial fulfillment of the requirements for the degree of Doctor in Buco-Dental Biology, area of Anatomy.

Orientador: Prof. Dr. Fausto Bérzin

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A Comissão Julgadora dos trabalhos de Defesa de Tese de Doutorado, em sessão pública realizada em 10 de Agosto de 2018, considerou a candidata LIEGE MARIA DI BISCEGLIE FERREIRA aprovada.

PROF. DR. FAUSTO BÉRZIN

PROFª. DRª. CRISTIANE RODRIGUES PEDRONI

PROF. DR. FRANCISCO JOSÉ DE MORAES MACEDO

PROFª. DRª. ANA CLÁUDIA ROSSI

PROFª. DRª. CÁSSIA MARIA GRILLO

A Ata da defesa com as respectivas assinaturas dos membros encontra-se no processo de vida acadêmica do aluno.

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Dedico este trabalho a todas as pessoas que sofrem de dores de cabeça.

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(Salmo 126:1-3)

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“ Nem tudo que conta pode ser contado.
E nem tudo que é contado, verdadeiramente conta ”

Albert Einstein

RESUMO

Cefaleias são dores de cabeça complexas, e entre as classificadas como primárias, destacam-se a cefaleia tensional e a enxaqueca. A origem da dor nas cefaleias é controversa, e há consenso que ambas reúnam componentes de natureza neurológica e vascular. Nas cefaleias tensionais existem interações entre fatores periféricos e centrais, porém nas enxaquecas discute-se a respeito da existência de um componente muscular. Devido ao local relatado da dor da enxaqueca situar-se na região dos músculos temporais e o processamento de ambos ocorrer através do sistema trigeminovascular, foi construída uma hipótese diagnóstica (HD) na qual enxaquecas podem ser diagnosticadas baseando-se em um comportamento muscular, ou seja: os músculos temporal e masseter ipsilaterais iniciam sua atividade e permanecem mais ativos que seus homólogos contralaterais durante o movimento de deglutição com intercuspidação dentária. O objetivo desta pesquisa foi estudar o comportamento eletromiográfico desses músculos em casos de cefaléias baseado nessa hipótese e o uso da eletromiografia no diagnóstico da enxaqueca. Este estudo incluiu 92 participantes do sexo feminino (62 com dor e 30 sem dor) para avaliar a HD, e foram analisados exames eletromiográficos dos músculos temporais e masseteres durante o período correspondente à deglutição, fornecido pela atividade registrada através dos músculos supra-hióideos. Os resultados apontaram para uma associação entre HD e dor durante a deglutição com intercuspidação dentária (ambos com $p < 0,01$ pelo teste do qui-quadrado), e o lado da dor identificado pela HD foi associado ao lado da dor relatada no diagnóstico clínico, porém ambos os resultados mostraram associação somente nos casos de enxaqueca ($p < 0,01$). O teste de regressão logística (taxa de correção de 96,70% e altas taxas de especificidade e sensibilidade) apontou a HD como um método eficaz de avaliação da presença de enxaqueca nos casos clinicamente diagnosticados. Conclui-se que existe uma associação do padrão eletromiográfico sugerido por HD com o diagnóstico clínico da enxaqueca, e que a HD é eficaz como método auxiliar de diagnóstico nestes casos.

Palavras-chave: cefaleia; enxaqueca; deglutição; músculo temporal; diagnóstico; eletromiografia.

ABSTRACT

Objective: *The purpose of this work was to validate a method to diagnose cephalalgia. The method is based on muscle activity and analyzes the electromyographic behavior of the temporal muscles associated with the masseter muscles.*

Methods: *To assess the starting time and intensity of activation of the masseter and temporal muscles, and evaluate the Diagnostic Hypothesis (DH), was recorded the surface electromyography (EMG) on temporal, masseter and suprahyoid muscles in 92 participants (62 in pain and 30 without pain). Were performed two types of deglutition tasks and through mathematical routines (Matlab), assessed a specific behavior of these muscles.*

Results: *The ratio of likelihood in the chi-square test and the logistic regression identified an association between DH and pain. However, the association was present only with migraine in deglutition with dental intercuspation. The DH also found that the side of the pain was associated with the side of the pain diagnosed.*

Conclusion: *The findings of this research showed that the method of diagnosis of cephalalgia based on muscular activity is effective in cases of migraine and may be useful to assist their diagnosis.*

Keywords: headache; migraine; deglutition; temporal muscles; diagnosis; electromyography.

LISTA DE ABREVIATURAS E SIGLAS

E: Enxaqueca
CT: Cefaleia tensional
EMG: Eletromiografia
TTH: Tension-type headache
WH: Without headache
SD: Spontaneous deglutition
DI: Dental intercuspation
DH: Diagnostic hypothesis

SUMÁRIO

1 INTRODUÇÃO

A sociedade internacional de cefaleias (IHS, 2018) as classifica como primárias (enxaquecas, cefaléias tipo tensão, e cefaléias trigemino-talâmicas) e secundárias (causadas por tumores, traumatismos, transtornos neurológicos, entre outros). Ambas podem ocorrer de forma crônica (mais de 15 dias por mês) ou episódica (menos de 15 dias por mês), e são importantes por apresentarem alta prevalência e altos impactos sociais, econômicos e pessoais, sendo a terceira causa de incapacitação em pessoas com menos de 50 anos em todo o mundo (IHS, 2018). Entre os fatores desencadeantes, o mais citado é o stress, seguido por um estado físico de fadiga, fatores hormonais, estímulos visuais, olfativos, uso de álcool, e ingestão de alguns tipos de alimentos (Peroutka, 2014).

A cefaleia tensional (CT), mais prevalente do que a enxaqueca, apresenta dor de característica difusa, descrita como uma sensação de aperto. (IHS, 2018). Relacionada com mecanismos periféricos (IHS, 2018; Munro, 1975) e avaliada em músculos temporais, mostrou contrações musculares sustentadas e agravadas por processos de sensibilização central em quadros mais frequentes (Jensen & Olensen, 1996). A enxaqueca (E) acomete cerca de 12% da população mundial, causando impacto significativo nas atividades da vida diária (Breslau & Rasmussen, 2001). É caracterizada por crises recorrentes e incapacitantes de dores geralmente unilaterais, pulsáteis e de alta intensidade, com duração de até 72 horas. As crises são associadas à maior sensibilidade às entradas sensoriais como luz e som (IHS, 2018), sendo que há estudos sobre relações intrínsecas entre os sistemas trigeminal e oculomotor (Valério, 2018).

A origem da dor nas cefaleias é controversa (Hatef et al., 2012). A patogênese da enxaqueca envolve a genética (Sutherland & Griffiths, 2017) e tanto a enxaqueca como a cefaleia tensional compartilham os mesmos padrões de desencadeamento e a mesma área de percepção de ativação ou seja, o sistema trigeminovascular (Pietrobom & Moskovitz, 2013; Shevel & Spierings, 2004). Este sistema nociceptivo é ativado quando ocorre dilatação arterial craniana e a inervação sensorial destes vasos libera substâncias químicas que causam uma inflamação neurogênica, associadas à diminuição da inibição da transmissão central da dor (Spierings, 2003).

O sistema trigeminovascular recebe no núcleo caudal do nervo trigêmeo, aferências viscerais (Moskowitz, 1990) e nociceptivas, que são moduladas pelo tronco cerebral, hipotálamo e córtex (Noseda & Burstein, 2013). Após a ativação, em poucos minutos, media a hipersensibilidade craniana e ativa sequencialmente neurônios de segunda e terceira ordem, os quais por sua vez mediam alodínea cutânea ipsilaterais e possivelmente contralaterais na cabeça, e outros sintomas. Desta forma, influenciam áreas talâmicas e corticais e o controle motor do sistema nervoso central, promovendo uma sensibilização e tendo como resposta a estes estímulos, a dor (Burstein, 2001; Sutherland & Griffiths, 2017).

Há consenso que as cefaleias reúnem componentes de natureza neurológica e vascular (IHS, 2018), e que nas cefaleias tensionais existem interações entre fatores periféricos e centrais (Jensen & Olensen, 1998), porém nas enxaquecas discute-se a respeito da existência de um componente muscular.

Foi sugerido um envolvimento miofacial na gênese da enxaqueca, também processado pelos neurônios caudais, onde estímulos periféricos nociceptivos contínuos aumentam o influxo vascular e se integram a efeitos facilitadores supra-espinhais, sendo registrados como dor (Olesen, 1991). Pontos-gatilho ativos nos músculos temporais ipsilaterais à enxaqueca também produzem estimulação contínua do núcleo caudal e ativação do sistema trigeminovascular (Fernández-de-Las-Peñas et al, 2006), e funções estomatognáticas também podem apresentar desequilíbrios e levar a dor (Douglas et al.,2010), destacando-se a importância da artéria temporal profunda posterior como responsável pelo suprimento vascular do músculo temporal, também mencionada na gênese da enxaqueca (Silva Neto, 2008).

Atualmente o diagnóstico de cefaleias é realizado com base nos critérios prescritos pelo “Committee of the International Headache Society” (IHS, 2018), que não considera a avaliação da atividade muscular relevante para a enxaqueca, porém a localização mais frequente da dor coincide com a região dos músculos temporais (Silva Neto, 2011).

Os músculos temporais atuam em múltiplas excursões mandibulares, incluindo lateralidades homólogas e contralaterais (Gray, 2010). Enquanto os músculos masseteres contribuem mais para a força de mordida, os músculos temporais, através de programas sensório motores precisos (Wong et al., 2011; Helman et al., 2014), fornecem um controle mais rigoroso da posição mandibular em

torno das cúspides dentárias durante a intercuspidação dentária (ID), do que os outros elevadores (MacDonald & Hannan, 1984; Ferrario et al., 1993).

O movimento de ID acontece durante a deglutição, que é um processo neurofisiológico complexo que ocorre em alta frequência (Okenson, 2008). Através da contração involuntária (Gray, 2010), breve e relativamente isométrica dos músculos temporal e masseter, e da atividade fásica dos supra-hióideos, a mandíbula é estabilizada em relação cêntrica para o correto controle do movimento do osso hióide (Shewman, 2006). Durante a ID, por meio de receptores periodontais, articulares, musculares e tendinosos, e da grande representatividade cortical (Areso, et al., 1999), ajustes complexos modulam os programas de controle motor, influenciando as funções estomatognáticas (Douglas et al.,2010). A posição da mandíbula durante a deglutição é determinada pela qualidade da ID (Okenson, 2008), e desvios laterais podem ocorrer durante atividades musculares em ID (Ferrario et al., 1993), recrutando um comportamento diferente dos músculos temporais e masseteres para os ajustes necessários ao equilíbrio dinâmico dessa função (Falda et al., 1998; Douglas et al., 2010).

A Eletromiografia (EMG), uma ciência substancialmente consolidada, permite a avaliação de músculos responsáveis por movimentos mandibulares (Nagae & Bérzin, 2004; Gonzalez & Bérzin, 2010). Estudos de atividade eletromiográfica de músculos mastigatórios são frequentes (Forrester et al., 2010), assim como trabalhos comprovando a contribuição musculoesquelética para a dor ou para a intensidade da dor (Siqueira & Teixeira, 2012), porém, a existência de uma ligação fisiopatológica entre as cefaléias e atividade muscular ainda está sendo discutida (Hatef et al., 2012), e os resultados tem sido pouco esclarecedores (Chapman, 1986; Hunning, 2000). Sabe-se no entanto que padrões de atividade de músculos mastigatórios podem ser afetados pela dor e podem ser identificados por variáveis temporais de EMG (Hatef et al., 2012).

JUSTIFICATIVA E OBJETIVOS

Considerando-se que a percepção dolorosa das enxaquecas acontece na região dos músculos temporais, e que o processamento nociceptivo do suprimento vascular / nervoso destes músculos e da vasodilatação craniana são realizados no mesmo local, foi construída a hipótese de que a enxaqueca poderia ser

diagnosticada com base na atividade dos músculos temporais, associada à do masseter. A hipótese diagnóstica (HD), em si, decorre da observação de que em casos de enxaqueca, os músculos temporais e masseteres ipsilaterais iniciam sua atividade e se mantém mais ativos que seus homólogos contralaterais durante o movimento de deglutição com intercuspidação dentária.

Os objetivos desta pesquisa foram:

- avaliar se a hipótese diagnóstica (HD) tem associação com casos diagnosticados clinicamente com enxaqueca.
- avaliar se a utilização da hipótese diagnóstica (HD) é eficiente como método auxiliar de diagnóstico de cefaleias.

2 ARTIGO

METHOD FOR HEADACHE DIAGNOSIS THROUGH ELECTROMYOGRAPHY

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ABSTRACT

Headaches involve complex conditions and bring together components of neurological and vascular nature as well as the possible existence of a muscle component, here discussed. The reported site of migraine pain is in the temporal muscle region.

Through the electromyographic recording of temporal and masseters muscles during deglutition tasks in headache cases, a specific behavior was found (DH: Diagnostic Hypothesis), which consists of the association between the onset activity time and the activation intensity of these ipsilateral muscles with respect to their contralateral counterparts, but only in migraine cases and during dental intercuspation coincident with the pain side diagnosed.

It is concluded that there is an association of the electromyographic pattern suggested by DH with the clinical migraine diagnosis, and that pattern can be used as an auxiliary diagnostic method through electromyography in migraine cases.

1. INTRODUCTION

Headaches have complex conditions, and among the so-called primary ones, were find the tension-type headache (TTH) and the migraine. Cephalalgias may occur chronically or episodically. They are quite relevant for being highly prevalent and for the social, economic, and personal impact it generates. In the world, cephalalgia is the third cause of people incapacitation for individuals under 50 [1], and stress is one of the most prevalent triggering factors [2].

TTH, more prevalent than migraine, presents diffuse pain characterized as a tightening sensation [1]. TTH is related to peripheral mechanisms [1,3], and when evaluated in temporal muscles, it showed sustained involuntary muscular contractions aggravated by central sensitization processes in more frequent cases [4,5]. Recurrent attacks of generally unilateral, pulsating, high-intensity pain associated with increased sensitivity to standard sensory inputs [1] characterize migraine. The origin of these two types of headaches is controversial [6,7]. Both migraine and TTH regard peripheral and central inputs, sharing the same trigger patterns and area of activation or activation perception, which is the trigeminovascular system [7-9]

When cranial arterial dilatation occurs, and the sensory innervation of these vessels releases chemical substance, the nociceptive system is activated. That event leads to extracranial neurogenic inflammation due to a decreased inhibition of central

pain transmission [10]. The trigeminovascular system, modulated by the brainstem, the hypothalamus and the cortex, in the caudal nucleus of the trigeminal nerve, receives the convergence of visceral and nociceptive entries. After a few minutes, it promotes a sensitization that, on its turn, mediates the symptoms of intracranial hypersensitivity and brings pain in response [11-13].

There is a consensus that headaches present neurological and vascular phenomena [1], and that in TTH cases, there are interactions between peripheral and central factors [5]. However, regarding migraine, there are discussions about whether or not there are muscular factors. A myofascial involvement in the genesis of migraine, also processed by caudal neurons, has been suggested. There, all nociception from cephalic arteries and pericranial myofascial tissues converge and integrate with supraspinal facilitatory effects, recorded as pain [14].

Active migraine triggering points in the temporalis muscles ipsilateral also produce continuous stimulation of the caudal nucleus and activation of the trigeminovascular system [3], and stomatognathic functions may also present imbalances, leading to pain [15]. Such event highlights the importance of the posterior deep temporal artery as responsible for the vascular supply of the temporal muscle, also mentioned in migraine genesis [16].

Currently, the diagnosis of headache is performed based on the criteria prescribed by the Committee of the International Headache Society (IHS) [1], which does not consider the assessment of muscle activity relevant to migraine. Nonetheless, the most frequent location of pain coincides with the region of the temporal muscles [17] that act on multiple mandibular excursions, including homologous and contralateral lateralities [18]. While the masseter muscles considerably contribute to the bite force, the temporal muscles provide a more

rigorous control of the mandibular position around the dental cusps during dental intercuspation (DI) than the other elevator muscles [19-22]. The movement of DI occurs during deglutition, which is a high frequency and complex neurophysiological process [23]. The mandible is stabilized in maximal intercuspation through the involuntary, brief and relative isometric contraction of the temporal and masseter muscles, and the phasic activity of the suprahyoid [24], for the correct control of the hyoid bone movement [23,25]. The final position of the mandible determines the quality of the DI [23] during deglutition. During DI, complex adjustments modulate motor control programs through periodontal, joint, muscle, tendon receptors, and their great cortical representation impact on the stomatognathic functions [15].

Considering that the painful perception of migraine exist in the region of the temporal muscles, and that the vascular/nervous supply of such muscles and the cranial vasodilatation have their nociceptive processing performed in the same place, can be inferred that migraine could be diagnosed based on the activity of temporal muscles associated with the masseter muscles activity. This diagnostic hypothesis (DH) stems from the assumption that in migraine cases, ipsilateral temporal and masseter muscles begin their activity and remain more active than their contralateral counterparts during deglutition movement with dental intercuspation.

Thus, at that stage, it was possible to test the DH applying the method in volunteers clinically diagnosed with or without migraine, quantifying their adherence to the traditional (IHS) and the proposed method (DH).

Therefore, first, another criterion may be established to diagnosis migraine based on an objective measurement of the muscular activity through electromyography. Secondly, can be may also showed a relationship between migraine and muscular components.

2. MATERIAL AND METHODS

2.1. Ethical Note

This study was approved by the Research Ethics Committee of the institution under protocol n° 69317617.3.0000.5418 - Plataforma Brasil and all participants signed the Informed Consent form.

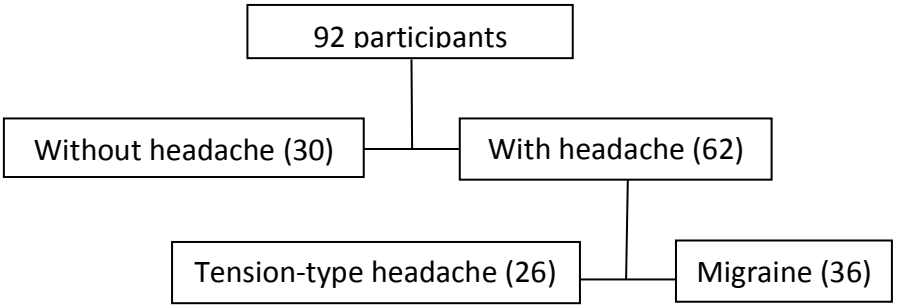
2.2. Sample population

The inclusion criteria were: women aged 18 to 49 without generalized body pain and abnormalities in the stomatognathic functions, with a complete dentition (except for third molars) in a basal correlation of the dental arches, not under treatments, and with oral contraceptives. Only the headache cases required the clinical diagnosis by a neurologist, based on the International Classification of Headache Disorders, 3rd edition [1]. The Research Diagnostic Criteria-RDC examination [26] identified the cases without pain. The sample population did not include participants who did not meet the inclusion criteria.

The participants in the group of people having headache also provided anamnesis data on pain characteristics such as type, triggering, and aggravating factors, all according to the research protocols. It also indicated the pain site in the Raffaelli's diagram, where they could point the exact pain location [17].

Finally, the sample participants consisted of 92 female aged 18 to 49 (average age 33.5 ± 15.5), distributed in two groups: NH group: no headache (n = 30), and WH group: with headache, of 62 participants divided into two subgroups: TTH (n = 26) and MIGRAINE (n = 36), as shown in Figure 1.

Figure 1: Flowchart of participants recruitment and inclusion.



2.3. Electromyographic evaluation

All participants were subject to electromyographic evaluation with the ADS1200 Lynx (Lynx® Electronic Technology Ltd.) 12-channel sampling equipment with a sampling frequency of 2000 Hz. The filtering of signals took place in the bandwidth from 20 Hz to 1000 Hz. The acquisition software used was the AqDados 7.02 and the signals viewed through the AqDAnalysis software. Were used meditrace 200, Ag / AgCl bipolar surface electrodes with a distance between the 20 mm poles adapted to masticatory muscles. After the cleaning with alcohol 70, were placed the electrodes in the region of more significant evidence of muscle mass, parallel to the muscle fibers, and on the skin covering the temporal muscles (anterior portion), masseters and suprahyoid, in these a single electrode in the mylohyoid raphe [25]. The reference electrode was placed on the skin covering the manubrium of the sternum bone. The participants sat with their backs straightened upright, heads unsupported, eyes fixed on the horizon, feet flat on the ground, had been previously trained in all tasks. Any of the participants was examineted under acute pain attack.

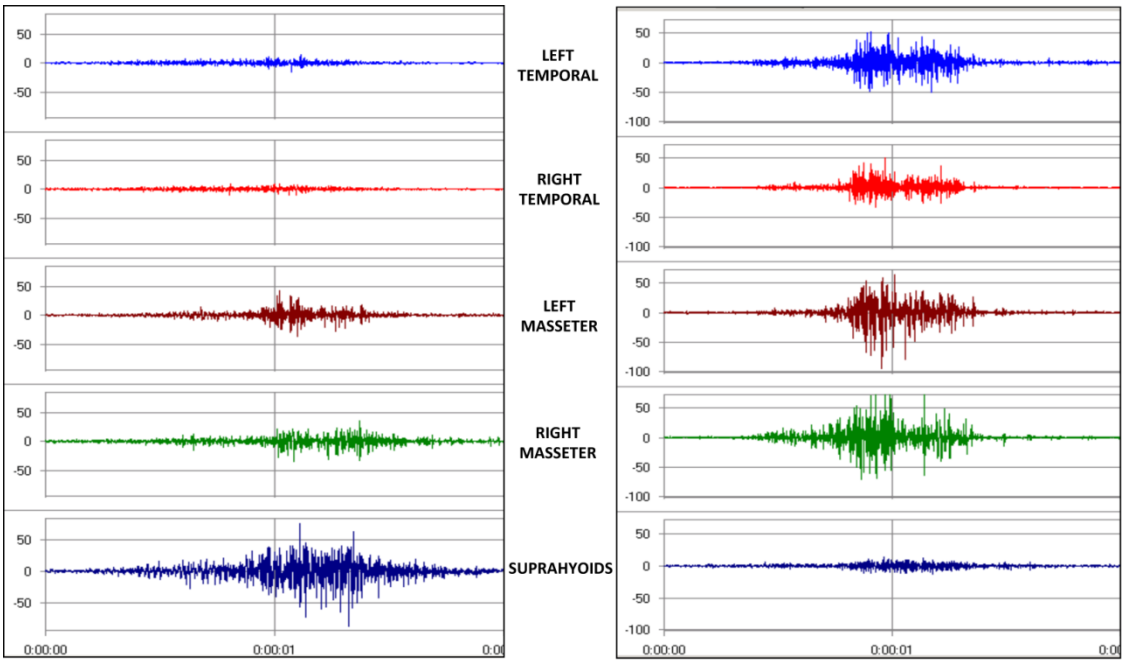
The electromyographic data was collected in two moments. First, the researcher made the anamnesis, explained about the equipment and the tasks to be

performed during the examination procedure. Second, on a different day, the following protocol was applied to all participants: six deglutition samples of 10 ml of water. Vaiman et al, 2004 [27], who stated that swallowing 20 ml at once generates stress and discomfort, was the basis to adapt the water volume. The deglutitions took place with labial sealing. In a pre-set period of five seconds each, the participants performed three spontaneous deglutition tasks without instructions, and three deglutition in dental intercuspation tasks (DI) with instructions to deglute, but not separate the dental arches, maintaining the teeth in comfortable contact, not pressing them.

After the three spontaneous deglutition tasks, the participants were trained to ensure consistency in the subsequent performance, the deglutition with dental contacts. They were asked to make three deglutitions and focus in this aspect. The participants were asked if they were able to follow the instructions of contacting their teeth without pressing or if they had kept the dental arcs separated during the task. If they couldn’t tell if their teeth were or not in contact, the measurement was repeated.

This research did not monitor intercuspation, and for that reason, it was not possible to accurately determine whether or not there were dental contacts. However, was tooked into account instruction, training, participants' response to post-training perception and visual feedback of increased activation of the elevator muscles related to the hyoids in the tests (Figure 2), and these parameters were considered due to DI at the deglutition time.

Figure 2: Electromyographic signs of spontaneous deglutition (A) and dental intercuspation (B).



A: spontaneus deglutition

B: deglutition with dental intercuspation

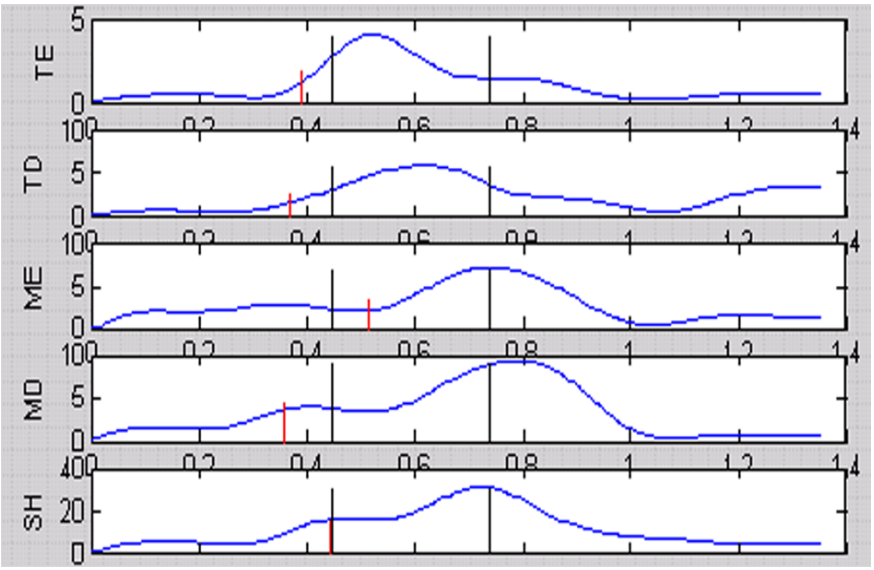
This study used the Matlab® (Matworks) to process the signal. Next, was created a particular protocol for this project. Then there was a blind evaluation of the electromyographic signals, not knowing to which group the participant belongs. For DH identification, was expected to distinguish DH in at least two of the three records of each type of deglutition (percentage of occurrence ≥ 66.66%).

It was not the objective of this study to evaluate the performance of the suprahyoid muscles, and so it only provided the markers of the onset and the end of the activity to confirm the deglutition phases.

Then, was evaluated the temporalis and masseters muscles using two associated variables. First, was considered the starting time of the activity, from rest to maximal intercuspation (analyzed in a unit of time). It was based on Shewman (2006) [24], who considers that this portion represents the patient's ability to promptly activate elevators muscles into maximal intercuspation during the preparation for the deglutition. In the present research, the mean signal plus six standard deviations

were established as the initial threshold to find the onset of activity of temporal muscles. Second, was considered the intensity of the activation (analyzed in RMS) of the temporalis and masseters muscles, during the oral and pharyngeal phases of deglutition, corresponding to the period of the suprahyoid muscles' activity. It was based on Vaiman et al (2004) [28], which describes the electromyographic characteristics of the phases of deglutition. In our research, the end of the pharyngeal phase was determined by the last point of stability before the beginning of the esophageal phase (Figure 3).

Figure 3: Muscles evaluated within the deglutition period: TE: left temporal; TD: right temporal; ME: left masseter; MD: right masseter; SH: suprahyoid.



2.4 Statistical analysis

The SAS package (SAS Institute Inc., version 9.3 SAS Institute Inc. Cary: NC, 2010) was used for statistical calculations setting the significance level at 5%,

through the chi-square, chi-square of likelihood ratio, and Cramer V tests, and also through the logistic regression.

3. RESULTS

Table 1. Frequency (percentage in the DH) and chi-square test of likelihood ratio for the hypothesis of absence of association between rows and columns of the table.

DH	Presence of headache		G^2 (P-value)
	Yes	No	
Yes	34 (100.00)	0 (0.00)	0.0001
No	26 (46.43)	30 (53.57)	

G^2: Chi-square of likelihood ratio

Integration of the muscular activity here called DH did not appear in the sample from a group of people without headache. As a consequence, that becomes a distinct and significant association (P <0.01) between the DH and the presence of headache.

On another hand, not all cases of headache were pointed by DH, since 26 cases of the headache group have not presented the muscular behavioral characteristics of DH.

For a complete analysis, were considered two kinds of headache in the sample: migraine and TTH. That is important in determining the specificity of the DH when establishing the cases of migraine, shown in table 2.

Table 2. Frequency (percentage in the diagnostic hypothesis) and likelihood ratio chi-square to the hypothesis of absence of association between rows and columns of the table.

Clinic diagnosis	Diagnostic hypothesis		G^2 (P)
	Yes	No	
Tension-type headache			
Yes	2 (7.41)	25 (50.79)	0.0001
No	32 (92.59)	31 (49.21)	
Migraine			0.0001

Yes	34 (37.78)	3 (3.30)
No	0 (0.00)	53 (58.89)

G^2: Chi-square of likelihood ratio

In table 2, it is possible to see the contrast between the DH application as a potential method to detect migraine, and another kind of headache, the TTH.

In the TTH or non-TTH groups clinically diagnosed groups, was found an inappropriate result of the DH, because there is not a consistent pattern of diagnostics in the muscular behavior.

When relating to the absence of association between the muscular behavior and DH, 50.79% of the cases referred to the TTH group, while 49.21% related to the non TTH group.

Additionally, when was observed muscular behavior, most cases (92.36%) refer to the non-TTH group, while was only found 7.41% (2 cases) in people diagnosed as TTH group.

When analyzing people diagnosed with or without migraine, were found different results. All (100%) cases in which the muscular behavior related to DH had been previously and clinically diagnosed as a migraine group. Additionally, migraine was not diagnosed in 94.64% where the muscular behavior (DH) was not observed. Therefore, were found a correction rate of 96.67% between the clinical diagnose of migraine and DH. To corroborate such data, the quality of DH in migraine diagnosis shows a sensitivity rate of 100%, specificity of 91.90%, low levels of false positive (5.40%), and may be considered false negative (0.00%) rates.

Accordingly, were investigated the migraine side and muscular behavior side detected, finding the results presented in table 3 below.

Table 3. Side reported of occurrence of migraine and detection of muscular behavior (DH).

Side	Presence of migraine	DH side			G^2 (P)
		Bilateral	Right	Left	
Right	No	0	0	10	0.0002
	Yes	1	16	8	
Left	No	0	11	1	0.0002
	Yes	1	5	17	

G^2: Chi-square of likelihood ratio

There is strong evidence of the correlation between the side of the migraine and DH (P <0.01). Such correlation reveals a direct relation since, in most cases, DH was detected on the same side of the migraine.

However, an important warning regards the type of deglutition in which DH had a higher incidence, presented in table 4.

Table 4. Frequency (percentage) of the HD in different types of deglutition tests in migraine diagnosed cases.

Type of deglutition		
Biphasic (both)	Intercuspation	Spontaneous
4 (11.43)	30 (85.71)	1 (2.86)

Chi-square test for equality of proportions (χ^2: 4.31 – P:0.0001)

Evidence are compelling in pointing to differences (P <0.01) between DH in different types of deglutition suggest the recording of electromyographic data in the intercuspation condition.

4. DISCUSSION

Supported by the findings of the present research and first observations, this study shows a clear association between the electromyographic pattern suggested

by DH and the clinical diagnosis of migraine (Table 1). Therefore, was verified that the method to diagnose headache based on muscle activity, here referred to as "DH", was an active and may be useful as an auxiliary diagnostic method for patients suffering from that headache.

Electromyography evaluated the DH from two variables: the activity and the starting time and their contralateral counterparts, in deglutition with dental intercuspation. Such a pattern of muscular behavior (DH) was identified in cases of migraine, coinciding with the reported pain side in the clinical diagnosis. As an auxiliary method to diagnose migraine, the DH evaluation showed a high specificity and sensitivity rate not yet found in the literature.

Muscle activity is a factor that triggers a headache. Unfortunately, migraine cases seldom discuss that, while migraine is a disorder where the temporal muscles region is a place of pain perception. DH is a muscular behavior detected in cases where there is a pain (Table 2); however, the method could not cover all types of pain since it represents a characteristic muscular pattern found in the migraine cases evaluated in this study. In most cases diagnosed as TTH, as in NH participants, DH was not identified, considering that a wide range of different muscular behaviors identified did not meet the specification of DH, i.e., any of the muscular behavior found in the two groups studied equaled the behavior found in people suffering from migraine.

A special note about the exams using electromyographic data records in the intercuspation condition should be made. The characteristic muscular pattern of DH, identified in the migraine group, was different from the patters found in the TTH group or NH participants, although all participants underwent the same deglutition tests: spontaneous and with intercuspation (Table 4).

During muscular activities united by teeth, lateral forces are admitted [20,29] which cannot be avoided in the pharyngeal phase of deglutition [30], when the mandible can raise vertically and be kept stable in DI [24,31-32]. Moreover, although the trigeminal ganglia neurons show fast adaptation, adaptive motor changes can occur and may be clinically destructive [15,33].

Deglutition is highly frequent [23,34], and the mechanical environment generated during DI is very complex [29], recruiting a special behavior from the temporal and masseters muscles for the necessary adjustments to the dynamic balance of this function. Consequently, it is considered that the evidence provided by DH of a postural control mechanism by both the temporal and the masseter muscles, is an immediate substantial neuromuscular adaptive response to a possible spatial deviation of the mandibular position during DI [15,20-22], contributing to the adequacy of the airways, an essential function for life [35-37].

That follows the perception-action cycle principle in which a specific motor action may be anticipated by a feed-forward mechanism aiming at reducing body oscillation allowing the efficient execution of different functions [15,38].

As pointed out in this work regarding the association of DH with the reported pain side in clinical diagnoses, the adaptative mandibular position may interfere in the execution of movement patterns controlled by the basal ganglia, and display pain in the muscles responsible for such activities [15].

The strong association between muscular activity and migraine diagnosis, and the high specificity and sensitivity rates attributed to the electromyographic evaluation through the muscular behavior (DH), allow suggests it as a diagnostic method to be used by dentistry with neurology, collaborating with the prognosis and therapeutics of

women with migraine. However, the criteria proposed are under development and will depend on more comprehensive studies to be supported.

5. CONCLUSIONS:

There is an association between the electromyographic pattern suggested by DH and the clinical migraine diagnosis. The method for the headache diagnosis based on muscle activity is effective in migraine cases and may be useful as a diagnostic aid in these cases.

There are no conflitcs of interest.

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6. REFERENCES

[1]. Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition. Cephalalgia. 2018 Jan;38(1):1-211.
[2]. Peroutka SJ. What Turns on a Migraine? A Systematic Review of Migraine Precipitating Factors. Curr Pain Headache Rep. 2014 Oct;18(10):454.
[3]. Fernández-de-Las-Peñas C, Cuadrado ML, Pareja JA. Myofascial trigger points, neck mobility and forward head posture in unilateral migraine. Cephalalgia. 2006 Sep;26(9):1061-1070.
[4]. Jensen RH. Tension-Type Headache - The Normal and Most Prevalent Headache. Headache. 2018 Feb;58(2):339-345.
[5]. Jensen R, Olensen J. Initiating mechanisms of experimentally induced tension-type headache. Cephalalgia. 1996; May;16(3):175-182; discussion 138-139
[6]. Shevel E. The extracranial vascular theory of migraine: an artificial controversy. J Neural Transm (Vienna). 2011 Apr;118(4):525-530.
[7]. Vargas BB. Tension-type headache and migraine: two points on a continuum? Curr Pain Headache Rep. 2008 Dec;12(6):433-436.
[8]. Shevel E, Spierings EH. Role of the extracranial arteries in migraine headache: a review. Cranio. 2004 Apr;22(2):132-136.

[9]. Pietrobon D, Moskowitz MA. Pathophysiology of migraine. Annu Rev Physiol. 2013;75:365-391.
[10]. Spierings EL. Migraine mechanism and management. Otolaryngol Clin North Am. 2003 Dec;36(6):1063-1078
[11]. Noseda R, Burstein R. Migraine pathophysiology: anatomy of the trigeminovascular pathway and associated neurological symptoms, cortical spreading depression, sensitization, and modulation of pain. Pain. 2013 Dec;154(Suppl.1):S44-S53
[12]. Moskowitz MA. Basic mechanisms in vascular headache. Neurol Clin. 1990 Nov;8(4):801-815.
[13]. Burstein R. Deconstructing migraine headache into peripheral and central sensitization. Pain. 2001 Jan;89(2-3):107-110.
[14]. Olesen J. Clinical and pathophysiological observations in migraine and tension-type headache explained by integration of vascular, supraspinal and myofascial inputs. Pain. 1991 Aug;46(2):125-132. [Cited in 2018, Sep10]
[15]. Douglas CR, Avoglio JLV, de Oliveira H. Stomatognathic adaptive motor syndrome is the correct diagnosis for temporomandibular disorders. Med Hypotheses. 2010 Apr;74(4):710-718.
[16]. Silva Neto RP, Roesler CP, Raffaelli Jr. E. The posterior deep temporal artery. Migraneas cefaléias 2008;11(2):60-62. https://www.researchgate.net/publication/262567801
[17]. Silva Neto RP. O uso de um diagrama craniano na localização da dor. [The use of a cranial diagram in pain localization].Headache Medicine. 2011;2(1):13-16. https://www.researchgate.net/publication/262567795
[18]. Henry Gray. Gray's Anatomy. 40a. Ed, pg 573. London. 2010. 573 p.
[19]. MacDonald JW, Hannam AG. Relationship between occlusal contacts and jaw-closing muscle activity during tooth clenching: Part II. J Prosthet Dent. 1984 Dec;52(6):862-867.
[20]. Ferrario VF, Sforza C, Miani A Jr, et al. Electromyographic activity of human masticatory muscles in normal young people. Statistical evaluation of reference values for clinical applications. J Oral Rehabil. 1993 May;20(3):271-280.
[21]. Hellmann D, Becker G, Giannakopoulos NN, et al. Precision of jaw-closing movements for different jaw gaps. Eur J Oral Sci. 2014 Feb;122(1):49-56
[22]. Hylander WL, Wall CE, Vinyard CJ, et al. Temporalis function in anthropoids and strepsirrhines: An EMG study. Am J Phys Anthropol. 2005;128(1):35-56.
[23]. Okenson J. Tratamento das desordens temporomandibulares e oclusão. [Manegement of Temporomandibular Disorders and Occlusion] 2008:36-37.
[24]. Shewman T. Surface Electromyography in temporomandibular disfunction. 2006th ed. Las Vegas, NV.Lundeen HC, Gibbs CH. Advances in occlusion. Boston 1982, John Wright PSC.
[25]. Hiraoka K. Changes in masseter muscle activity associated with swallowing. J Oral Rehabil. 2004 Oct;31(10):963-967.

[26]. Dworking SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J. Craniomandib Disord. 1992 Fall; 6(4): 301-355.
[27]. Vaiman M, Eviatar E, Segal S. Surface electromyographic studies of swallowing in normal subjects: a review of 440 adults. Report 1. Quantitative data: timing measures. Otolaryngol Head Neck Surg. 2004 Oct;131(4):548-555.
[28]. Vaiman M, Eviatar E, Segal S. Surface electromyographic studies of swallowing in normal subjects: a review of 440 adults. Report 3. Qualitative data. Otolaryngol Head Neck Surg. 2004 Dec;131(6):977-985.
[29]. Katona TR, Eckert GJ. The mechanics of dental occlusion and disclusion. Clin Biomech (Bristol, Avon). 2017 Dec;50:84-91.
[30]. Ramfjord SP. Bruxism, a clinical and electromyographic study. J Am Dent Assoc. 1961;62:21-44. [Cited in 2017, Jan 10]
[31]. Lundeen HC, Gibbs CH. 1982. Advances in occlusion. Postgraduate Dental Handbook, vol 14, John Wright Publisher, University of Florida, Gainesville, Florida, 7-10.[Cited in 2017, Jan 10]
[32]. Ross CF, Hylander WL. Electromyography of the anterior temporalis and masseter muscles of owl monkeys (Aotus trivirgatus) and the function of the postorbital septum. Am J Phys Anthropol. 2000 Aug;112(4):455-468.
[33]. Dawson, P.E., 2006. Functional Occlusion: From TMJ to Smile Design. Mosby, St. Louis, MO.
[34]. Lear CS, Flanagan JB, Moorrees CF. The frequency of deglutition in man. Arch oral biol. 1965 jan-feb;10:83-100. [Cited in 2019, Feb 26]
[35]. Gonzalez HE, Manns A. Forward head posture: its structural and functional influence on the stomatognathic system, a conceptual study. Cranio. 1996 Jan;14(1):71-80. [Cited in 2005, jul 23].
[36]. Bosma J. Oral and pharyngeal development and function. J Dent Res. 1963 Jan-Feb;2:375-380. Cited in Linder-Aronson S: Naso-respiratory function and craniofacial growth. In: McNamara J, ed. Nasorespiratory function and craniofacial growth and development. The University of Michigan, Ann Arbor 1979:233.
[37]. Tingey EM, Buschang PH, Throckmorton GS. Mandibular rest position: a reliable position influenced by head support and body posture. Am J Orthod Dentofacial Orthop. 2001 Dec;120(6):614-622
[38]. Barela JA. Estratégias de controle em movimentos complexos: ciclo percepção-ação no controle postural. [Control strategies in complex movements: perception-action cycle in postural control]. Rev Paulista Ed Fis. 2000; (Suppl 3):79-88. https://www.researchgate.net/publication/228958740.

3 CONCLUSÕES

1. Comprovou-se a associação entre o quadro de dor diagnosticado clinicamente como enxaqueca, e o padrão eletromiográfico sugerido pela hipótese diagnóstica – HD.
2. O método para o diagnóstico de cefaleias baseado em atividade muscular mostrou-se eficaz para casos de enxaqueca, podendo ser útil como auxiliar de diagnóstico nestes casos.

REFERÊNCIAS

Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition. [No authors listed] Cephalalgia. 2018 Jan;38(1):1-211.

Peroutka SJ. What Turns on a Migraine? A Systematic Review of Migraine Precipitating Factors. Curr Pain Headache Rep. 2014;18(10).

Munro RR. Electromyography of the masseter and anterior temporalis muscles in the open-close-clench cycle in temporomandibular joint dysfunction. Monogr Oral Sci. 1975;4:117–25.

Jensen, R; Olensen J. Initiating mechanisms of experimentally induced tension-type headache. Cephalalgia. 1996;May;16(3):175–82; discussion 138–9.

Breslau N, Rasmussen BK. The impact of migraine: epidemiology, risk factors, and co-morbidities. Neurology. 2001;56(suppl 1):S4- S12.

Valério P. Where mouth meets eye. EC Ophthalmology 9.7 (2018) https://www.ecronicon.com/ecop/pdf/ECOP-09-00341.pdf.

Hatef B, Talebian S, Hashemirad F, Ghaffarpour M. Effect of pain on the timing pattern of masseter muscle activity during the open-close-clench cycle in the migraine without aura and tension type headaches. Iran J Neurol. 2012;11(4):146–50.

Sutherland HG, Griffiths LR. Genetics of Migraine: Insights into the Molecular Basis of Migraine Disorders. Headache. 2017;57(4):537–69.

Spierings ELH. Migraine mechanism and management. Otolaryngol Clin North Am. 2003;36(6):1063–78.

Pietrobon D, Moskowitz MA. Pathophysiology of Migraine. Annu Rev Physiol.2013;75:365-91.

Shevel E, Spierings EH. Role of the extracranial arteries in migraine headache: A review. Cranio. 2004;22(2):132–6.

Moskowitz MA. Basic mechanisms in vascular headache. Neurol Clin. 1990 Nov;8(4):801-15.

Noseda R, Burstein R. Migraine pathophysiology: Anatomy of the trigeminovascular pathway and associated neurological symptoms, cortical spreading depression, sensitization, and modulation of pain. Pain. 2013;154(Suppl. 1):S44-S53.

Burstein R. Deconstructing migraine headache into peripheral and central sensitization. Pain. 2001 Jan;89(2-3):107-10.

Jensen R, Bendtsen L, Olesen J. Muscular factors are of importance in tension-type headache. Headache. 1998 Jan;38(1):10-7.

Olesen J. Clinical and pathophysiological observations in migraine and tension-type headache explained by integration of vascular, supraspinal and myofascial inputs. Pain. 1991 Aug;46(2):125-32. Cited in 2018, Sep10

Fernández-de-Las-Peñas C, Cuadrado ML, Pareja JA. Myofascial trigger points, neck mobility and forward head posture in unilateral migraine. Cephalalgia. 2006 Sep;26(9):1061-70

Douglas CR, Avoglio JLV, de Oliveira H. Stomatognathic adaptive motor syndrome is the correct diagnosis for temporomandibular disorders. Med Hypotheses.2010;74(4):710–8.

Silva Neto RP, Roesler CP, Raffaelli Jr. E The posterior deep temporal artery. Migrâneas cefaléias 2008;11(2):60-62).

Silva Neto RP. O uso de um diagrama craniano na localização da dor. Headache Medicine. 2011;2(1):13-16.

Henry Gray. Gray's Anatomia. 40a. edição. London. 2010. 573 p.

Wong D, Dzemidzic M, Talavage TM, Romito LM, Byrd KE. Motor control of jaw movements: An fMRI study of parafunctional clench and grind behavior. Brain Res. 2011;1383:206–17.

Hellmann D, Becker G, Giannakopoulos NN, Eberhard L, Fingerhut C, Rammelsberg P, et al. Precision of jaw-closing movements for different jaw gaps. Eur J Oral Sci. 2014;122(1):49–56.

MacDonald JW, Hannam AG. Relationship between occlusal contacts and jaw-closing muscle activity during tooth clenching: Part II. J Prosthet Dent. 1984 Dec;52(6):862-7.

Ferrario VF, Sforza C, Miani AJ, D'Addona A, Barbini E. Electromyographic activity of human masticatory muscles in normal young people. Statistical evaluation of reference values for clinical applications. J Oral Rehabil. 1993;20(3):271–80.

Okenson J. Tratamento das desordens temporomandibulares e oclusão. 6ª ed.2008. Editora Elsevier.p36-37

Shewman T. Surface Electromyography in temporomandibular disfunction. 2006th ed. Las Vegas, NV: Advanced Aesthetic and NeuroMuscular Solutions (AANMS).

Areso MP, Giralt MT, Sainz B, Prieto M, García-Vallejo P, Gómez EM. Occlusal Disharmonies Modulate Central Catecholaminergic Activity in the Rat. J Dent Res. 1999;78(6):1204–13.

Falda V, Guimarães A, Bérzin F. Eletromiografia dos músculos masseteres e temporais durante deglutição e mastigação. Rev Assoc Paul Cir Dent. 1998; 52(2):151-7.

Nagae M, Bérzin F. Electromyography: applied in the phonoaudiology clinic. Braz J Oral Sci.2004;3:506-9.

Gonzalez DAB, Berzin, F, Costa JM, Gonzalez, TO. Electromypgraphy study of stomatognatic system muscles during chewing of different materials Electromyography and Clinical Neurophysiology. 2010;50:121-127.

Forrester SE, Allen SJ, Presswood RG, Toy AC, Pain MT. Neuromuscular function in healthy occlusion. Oral Rehabil. 2010;37:663-669.

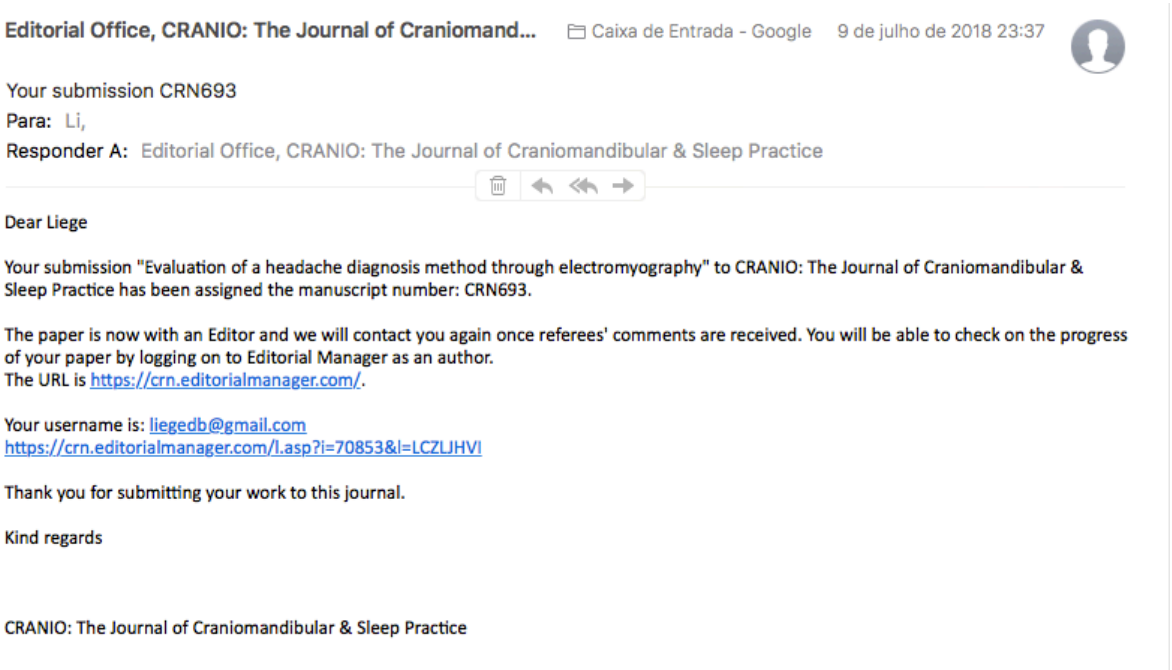
Siqueira J, Teixeira M. Dores Orofaciais - Diagnóstico e Tratamento. São Paulo: Editora Artes Médicas; 2012. p60-61.

Chapman SL. A review and clinical perspective on the use of EMG and thermal biofeedback for chronic headaches. Pain 1986; 27:1-43.

Hunning, SV. Estudo dos distúrbios oclusais em posição máxima com papel articular e palpação dos músculos Masseter superficial e Temporal (porção anterior) anterior numa mostra de portadores de cefaléia cronica tipo Migraine e voluntários normais. [dissertação]. Porto Alegre: Universidade Federal do Rio Grande do Sul; 2000.

ANEXO I

Comprovante de submissão do artigo



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ANEXO II

Folha de Aprovação do Comitê de Ética e Pesquisa – FOP/UNICAMP

COMITÊ DE ÉTICA EM PESQUISA
FACULDADE DE ODONTOLOGIA DE PIRACICABA
UNIVERSIDADE ESTADUAL DE CAMPINAS

CERTIFICADO

O Comitê de Ética em Pesquisa da FOP-UNICAMP certifica que o projeto de pesquisa "**Avaliação do comportamento do músculo temporal (vista frontal) em casos de cefaléias**", CAAE **69317617.3.0000.5418**, dos pesquisadores **Liege Maria Di Bisceglie Ferreira** e **Fausto Bérzin**, satisfaz as exigências das resoluções específicas sobre ética em pesquisa com seres humanos do Conselho Nacional de Saúde – Ministério da Saúde e foi aprovado por este comitê em 27/11/2017.

The Research Ethics Committee of the Piracicaba Dental School of the University of Campinas (FOP-UNICAMP) certifies that research project "**Evaluation of temporal muscle behaviour (frontal view) in cases of headaches**", CAAE **69317617.3.0000.5418**, of the researcher's **xxxxxx** and **xxxxx**, meets the requirements of the specific resolutions on ethics in research with human beings of the National Health Council - Ministry of Health, and was approved by this committee on the 27th of November of 2017.

Profa. Fernanda Miori Pascon
Vice Coordenador
CEP/FOP/UNICAMP

Prof. Jacks Jorge Junior
Coordenador
CEP/FOP/UNICAMP

Nota: O título do protocolo e a lista de autores aparecem como fornecidos pelos pesquisadores, sem qualquer edição.
Notice: The title and the list of researchers of the project appears as provided by the authors, without editing.

ANEXO III

Relatório de Originalidade